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SOME PRINCIPLES AND EXPERIENCE
CONCERNING UTILIZATION OF WATER
RESOURCES IN CZECHOSLOVAKIA

by

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a) The Increased Demand for Continental Water and the Gradual
Deterioration of its Quality.

With to the growth of population, the standard of living and economic development in all advanced countries, the demand for water and its actual consumption are continuously increasing. At the same time, the present rate of water contamination hinders the further development of these countries to a great extent.

A planned and controlled conservancy of the water supply, which is one of the essential natural resources, is therefore of utmost importance.

It has become essential to speed up the percolation of atmospheric precipitation into the ground, to recharge the ground water storage and to reduce losses by evaporation.

Impounding reservoirs not only ensure regular draining but also provide water during low-flow periods.

Another requirement is to keep the quality of the water within acceptable limits.

b) Rational Water Conservancy Requires International Cooperation

Any interference with the flow or the quality of water in an ups ream country affects conditions in all down-stream countries.

International cooperation in the exploitation of water resources has therefore become a necessity. The Danube, for instance, is of vital importance to 8 countries.

Such international cooperation is also necessary in complex scientific research. The prevailing local solutions have to give way to world-wide schemes in the field of observations and research,

i.e. in ionosphere for long-range weather forecast or in hydraulics, hydraulics, hydrology, hydro-engineering, hydro-geology, hydro-pedology, hydro-biology and hydro-chemistry.

c) Brief Survey of Hydro-Geography of Czechoslovakia.

Czechoslovak streams are drained by the Elbe into the North Sea, by the Odra and Visla into the Baltic and by the Danube into the Black Sea. Connection between the Baltic and the Mediterranean Sea could be shortened by the projected Danube-Odra Canal.

Atmospheric precipitations vary widely, in accordance with altitudes and temperatures within a range of from less than 400 mm to 1,600 mm annually and yield about 93 milliards of cubic metres a year. Almost one third of the country is densely forested. The flood rates are very high and natural flow (not including the Danube) varies between 14 milliard c.m. and 28 milliard c.m. The annual per capita rate of available water is thus only 2,050 c.m.

Flood records of the Vltava River have been kept since the 12th Century, complex hydro-graphic service dates back to 1874 and hydrological research was also established early.

d) Vasic Scheme for Planned Water Conservancy in Czechoslovakia

Since 1945 all natural resources of the country are the property of the State. In view of the fact that economic utilisation of water resources is particularly important for the development of the entire national economy, a " General Plan of Water Conservancy" elaborated on the initiative of the Government and passed in 1953, provides for the efficient utilisation of water in the interests of the entire national economy.

The plan is based on a reliable estimate of the ground water storage and the possibility of its accumulation as well as the utilisation of surface waters. It determines the requirements for its quantity and quality, its location and time according to the actual demands of the different branches of industry; the perspective demands of all other fields have also been taken into consideration. The possibilities have been incorporated into the final balance of water conservancy with the view to putting the actual future provisions of the plan into conformity with all

demands of the economic development of the country. The plan is flexible enough to provide for adaptation to possible variations and can be supplemented, enlarged, and improved. It was the first of its kind.

For periods of drought, measures for accumulating water have been considered to keep the flow rate regulated above a certain limit. According to this provision the quality thus attained is to meet at least category III of the Czechoslovak standard.

This plan, which is authorised by the Government, thus incorporates the principles for an efficient exploitation of water and a new bill on the utilisation of water resources. It ensures that the demands of water for all branches of the economy are met in time.

e) Augmentation of Water Supply by Storage

Czechoslovakia has an ingenious system of large fish-ponds, which were built between the 13th and 16th Centuries; the Builders of such ponds were also in great esteem and demand in the neighbouring countries of the then independent Czech state. The influence of these ponds is felt even today in the effective lowering of the peak-flow run-off from the respective drainage regions.

Special care is now devoted to the construction of big "key reservoirs. In regions with unfavourable hydrological, orographical or geological conditions re-pumping of the run-water is planned to more advantageous sites. On the Vltava River there is a system of dams and reservoirs with weirs, on the Elbe River a cascade of weirs and canals, and on the Váh River, a system of weirs and accumulation reservoirs.

By 1945, a total reservoir capacity of 0.25 milliard cu.m. was completed, by 1960 almost 1.4 milliard cu. m. and the planned capacity for 1965 is 2.6 milliard cu.m. According to the state plan for water conservancy, a total of about 10 milliard cu.m. of stored water will be available after the final completion of all possible and economically useful reservoirs.

f) Canalization of Rivers for Navigation Purposes, the Use of Rivers
Canalization as Source of Water Supply. Further Advantages of
Canalization.

An effective system of inland waterways is of great importance

for international trade. The depth necessary for safe navigation is ensured in Czechoslovakia by effective canalization, specially on the Vltava and Elbe Rivers, with a system of weirs, dams and navigation chambers, which make the disadvantageous discharge of valuable supplies of water from reservoirs unnecessary. Canalization on the Elbe affords passage for ships down the river to Hamburg. On the territory of the GDR, however, canalization of the Elbe has not yet been accomplished.

The building of large dams, especially on the canyon-like stretch of the Vltava above Prague, which is controlled and fed by large reservoirs on the upstream tract, has become an important source of power. A system of waterways and elevators for big ships and big heads is being developed. Thus big reservoir capacities and heads are gained while only a minimum quantity of water is required for navigation. Under favourable conditions these reservoirs are also of great importance for the quality of the water.

g) Hydro-power in Czechoslovakia Serves mainly to Cover Peak-loads.

The available amount of water power in Czechoslovakia is limited by its comparatively small and low-flowing streams. The ultimate attainable goal is the utilization of about 10 milliard kWh. annually. This basic load in the diagram is covered mainly by thermal power stations, and hydro power plants, especially at big reservoirs, serve mainly to cover peak-loads. Great achievements were made especially in the construction of Kaplan turbines with swivelling blades (Kaplan was a professor at the Technical College of Brno where he invented and developed this type of turbine). Their main advantage is not only their large capacity but the great head achieved in our country without danger of cavitation (aggregates of a capacity of 150 cu.m. per second, a head of 71 m. and an effectiveness of 92 %).

h) Progressive Methods of River Regulation.

Regulation of big rivers was formerly undertaken according to their number and especially during the vegetative period to protect the valleys and farmland. The result was usually that the ground water level was reduced in dry periods and the earth dried out. Meanders in the past were too radically straightened out by canals

which caused a rapid and disadvantageous run off and the flow-rate increased so much that it adversely affected the stability of the river-bed.

Today we try to limit floods if possible by accumulation in protection reservoirs while keeping river-beds relatively shallow, which prevents too great a drop in the water level in a dry period, and supports the possibility of natural water purification. If the protection reservoirs fail to check floods, low levees are built along the river banks.

In developing Potapov's method (USSR) of using flow guides to protect the banks and to form a river-bed with hydraulic equilibrium, we elaborated this method theoretically and applied it in our country.

1) Major Problems Concerning the Quality of Water.

In addition to providing the necessary quantity, the second biggest problem of Czechoslovak water conservation is the purity of the water.

Half a milliard crowns are invested annually by the Czechoslovak government in the construction of about 100 treatment stations for discharge waters.

Despite the continued general deterioration of the quality of water, a considerable improvement can be observed locally, where the effect of completed water treatment stations, of which there are over 600, is felt.

This is why we endeavour to introduce such progressive technological methods in industry in which a minimum amount of discharge water is produced, to speed up research in biology, chemistry and sanitary engineering to make the discharge waters innocuous, and new radical changes in technology in discharge water treatment.

Examples of some successes achieved here :

Production process in sugar mills limiting discharge waters to a minimum; application of these methods in other sugar mills resulted in the fact that no impairment to the quality of the water leaving Czechoslovakia could be detected during the sugar-processing season. Elsewhere the content of phenols was reduced by 50 % without construction of special installations. Joint biological and sanitary engineering research reduced the proportion of sulphates in discharge waters in the production of citric acid by more than 80 % when methanolic fermentation was used. Innocuity of discharge waters in industry is becoming increasingly a question

of economy. We also deal with eliminating radioactivity of water, of removal of detergents and water from sulphite cellulose, from synthetic rubber production, etc.

We do not under-estimate the natural clarification process in rivers and support it in river regulation by air-blowing at falls, from the view point of distributing the temperature, etc.

For improving discharge water we use ashes and slag, great quantities of which are produced in Czechoslovakia.

In hydraulic slag conveyance discharge water can be absorbed and phenols and other substances detained.

With the water shortage, future plans must envisage re-circulation which even today can be sixfold.

j) Impounding Reservoirs as Source for Domestic and Public Supply

If we do not want to dry out the land by draining off ground water, we must use and treat surface water. We carry on research of water in reservoirs so that oligotrophy may be maintained as long as possible.

Complex dynamic, physical, biological and chemical processes take place in water reservoirs. A study of the occurrence of substances in water entering and leaving the reservoirs has shown that the content of some substances in the water is greatly reduced while it is in the reservoir.

The influence of phosphorus from fertilizers on the formation of water plants has been confirmed. The effect of nuclear test explosions was ascertained by the precipitation of radioactive particles on the reservoir surface which was reduced by one-sixth over the same month last year when nuclear tests were stopped.

For irrigation purposes properly equipped intakes should withdraw water from the warm upper strata. For industrial purposes, especially for cooling purposes, cool water from the bottom without withdrawing the warmer strata should be used. The depth of the water layer which comes into play will be used according to the amount of water drained, so that the density of currents is used only in deep and large reservoirs.

k) Modern Methods of Water Treatment.

Research in Czechoslovakia is directed specially on treatment of drinking water from reservoirs and rivers with a view to coagula-

tion, separation and suspension in fixed and fluidized filtering beds and filtration of treated water. Hydrodynamics of fluidized filtering beds the mechanism of adhesion in porous mediums, theory of coagulation were clarified.

On the basis of this research methods and installations for water treatment in a two-stage process were worked out: "Sludge Blanket Clarifier" (ČSAS - patent) which is based on a fluidized bed filter followed on by high-rate filtration. The equipment can be constructed as a so-called "Packaged Water Treatment Plant", which can be easily transported. It comes in different unit sizes of a capacity of 2 to 100 litres per second for medium and very contaminated surface water, or for ground water with a high content of Fe and Mn. A mobile water-treatment plant with a capacity of 6 cu.m. per hour has been developed which supplies fresh and innocuous water in remote and poorly accessible areas and is equipped with its own self-supplying generator. It is very effective in treatment of highly concentrated bacterial pollution and any other substances if in suspension (not dissolved substances).

This equipment is suitable for providing innocuous water in the under-developed countries, where innocuous water treated from local surface water is a condition for the country's development. The equipment proved to be expedient even in difficult sub-tropic conditions.

We would like to recommend to the United Nations Council for Aid to the Under-developed Countries, and the World Health Council, that an expedition be sent to the sub-tropic or tropic zone, where the demand for fresh, innocuous water appears to be most pressing, to test the usefulness and suitability of the equipment. The expedition would also investigate special problems of sanitary significance in combating water-borne epidemic diseases.

1) Conclusion

In order to ensure now and in the future an adequate amount of fresh water for the steadily growing population and for the development of agriculture and industry, rational water conservancy should be introduced, complex development of questions related to water conservancy on an international scale and with international cooperation, international cooperation in the development of those aspects on which the development of rational water conservancy depends, measures on an international scale for the accumulation of

water specially by building big reservoirs at the most advantageous sites on international rivers, transfer of water from rivers abundant in water to rivers whose water does not suffice for the basic requirements, biological, chemical, sanitary and health research with a view to problems of purity of water.

